Human-cat relationship in an oceanic Biosphere Reserve: the case of La Palma Island, Canary Archipelago

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ABSTRACT

Removal of feral cats from island environments is useful mechanism by which their ecological impact on endangered species can be reduced or ended. Nevertheless, because cats are anthropogenic in their origins, social perceptions of management practices play a large role in their implementation. Four-hundred questionnaires were delivered (386 were returned) with 100 going to each of the following: local residents, environmental workers, tourists, and hunters. Questions explored respondents' knowledge about island biodiversity and invasive species as well as attitudes towards cat population management methods. Habitat destruction and introduction of invasive species were considered the main threats for the conservation of island biodiversity. Most respondents considered cats to have a negative impact on biodiversity and sterilization campaigns were considered most appropriate for cat population control. Several free sterilization campaigns have been conducted in La Palma Island Biosphere Reserve in order to reduce free-ranging cats and were well received by local people. This research, which combined concepts of management, ecology and social sciences, provides valuable insights which may to be applicable on other several islands where cats and people are present and in conflict with conservation priorities.

Keywords: Conservation; *Felis catus*; Invasive species; Oceanic islands; Questionnaires; Human-animal relationship.

Introduction

The domestic cat (*Felis catus*) originates from the Near Eastern wildcats (*Felis silvestris lybica*) approximately 9000 years ago (Driscoll et al., 2007). This commensal relationship likely arose from the cat's ability to effectively control rodents but has, over time, developed into one of companionship (Turner, 2000). Three different statuses for cats have been broadly described depending on their associations with humans: (1) house/pet/companion cats living with people that provide food, affection and shelter; (2) stray or roaming cats linked to one or several households which receive some of their nutritional needs from people but may be required to hunt, and (3) feral cats independent of humans that reproduce and feed independently of people and anthropogenic food sources (see Farnworth et al., 2010a; Liberg et al., 2000).

Cats, brought by people, have dispersed worldwide including to many remote islands, where populations have become feral (Fitzgerald & Turner, 2000). Once introduced, cats mainly preyed upon other introduced mammals but also native mammals, birds, reptiles and insects (Bonnaud et al., 2011), being responsible, at least in part, for 8% of global bird, mammal and reptile extinctions and the decline of almost 14% of critically endangered vertebrates on islands (Medina et al., 2011).

Predation strongly impacts upon prey population dynamics both in terms of companion (pet) cats in urban and suburban habitats (Woods et al., 2003) and stray and feral cats in uninhabited environments (Fitzgerald & Turner, 2000). For this reason, cats are considered as one of the 100 worst invasive species (Lowe et al., 2000).

Faced with issues related to cat presence, eradication campaigns have been conducted on 100 islands worldwide (DIISE, 2014) using a range of techniques including trapping, hunting, poisoning, and introduction of diseases (Campbell et al.,

2011; Nogales et al., 2004). Extirpation of feral cats from islands is a powerful conservation tool strongly supported by conservation organisations (Farnworth et al., 2014). Nevertheless, on inhabited islands social factors can restrict its implementation because the opposition of cat owners or animal rights organizations (Nogales et al., 2013; Parkes et al., 2014). Thus, other management strategies like trap-neuter release, trap-neuter release with removal of kittens for adoption, trap-test-vaccinate-alter-return-monitor, trap-euthanize, and inaction are more often accepted (Loyd & DeVore 2010). Although potentially useful for small-managed groups of cats these processes may be too expensive and not efficient enough to be applied across larger cat populations (Lohr et al., 2013; Metsers et al., 2010). As unowned (stray) cat numbers are positively correlated with human population density (Aguilar & Farnworth, 2012, 2013), it is crucial to obtain analyses of social, cultural, and economic issues to increase the possibility that local communities support removal managements (Proulx, 1988; Oppel et al., 2011). Cat populations can therefore be seen as an anthropogenic problem requiring community-based solutions.

Questionnaires are suitable tools to obtain public or stakeholder perceptions regarding human impacts on ecosystems, ecological management processes as well as animal management, invasive mammal impacts and human-wildlife conflicts (Farnworth et al., 2014; White et al., 2005). Some of them were used to measure human attitudes toward cats specifically (Turner, 2000) and focused on different aspects like cat-human relationships (Franklin, 2007), interdependence (Haspel & Calhoon, 1990), management options (Farnworth et al., 2011), or predation rates (Tschanz et al., 2011).

In the Canary Islands owners release kittens into the wild increasing feral cat populations and generating a major issue for the conservation of endangered species (Medina & Nogales, 2009). Consequently, several control programs were conducted to

minimize cat population dynamics and its subsequent impact on native wildlife. To avoid undesirable conflicts between animal right organisations and conservation biologists, effective information and education campaigns were considered as a basic tool (Medina & Nogales, 2009; Rando, 2004). Despite this, few questionnaires had been carried out on islands taking into account human attitudes and social perceptions as they relate to the presence and effects of cats on island ecologies. There have been no such studies on most of the 5% of the worlds´ 179,000 small and medium sized islands where cats have been introduced (B.R. Tershy, personal communication) including the Canaries. The main objective of this contribution is to establish, through a questionnaire, the opinion of specific groups of La Palma Island Biosphere Reserve inhabitants toward the effect of cat presence on island ecosystems. Specifically, we aim to evaluate the following: (1) the inhabitant's knowledge about island biodiversity and the consequences of invasive species, (2) the inhabitant's opinion about cat presence, and (3) their attitude towards cat population management. Each of these is considered in light of the respondents' specific interest group those being: local residents, environmental workers, tourists, and hunters.

Material and methods

Study area

The Canarian archipelago is situated in the Atlantic Ocean, some 100 km off the African continent. With an area of 728 km^2 and an altitude of 2426 m a.s.l. (Roque de Los Muchachos), the island of La Palma (28° 40' N, 17° 50' E) is located in the north-

west of the archipelago. Island's climate is influenced by the ecological zones associated with its altitude, the wet north-east trade winds, and the mountain orientation given a highly differentiated vegetation belts (see del Arco et al., 1999 for details).

A relative small area (511 ha) on the island was declared a Biosphere Reserve in 1983 (El Canal y Los Tiles). Nevertheless, considering both the natural value of this island and the fact that only conservation programs were carried out during a long period, the entire island was declared as Biosphere Reserve in 2002, to comply with the other two functions of these natural spaces: development and logistic. Biosphere Reserves are recognised areas of representative environments which have been internationally designated within the framework of UNESCO´s MAB Program for their value to conservation through providing the scientific knowledge, skills and values to support sustainable development (Bridgewater & Cresswell, 1998).

Questionnaires

Similar to the work of Farnworth et al. (2014) and based on knowledge of the population under exploration four groups of respondents were purposively sampled . Such sampling techniques were predicated upon the assumption that points-of-view with respect to invasive predators (cats) and ecosystem conservation on the island would differ amongst groups of users. As per the aims of this work, exploring this dynamic was integral to understanding conflicts which may arise. Groups included were: local residents (to provide a non-specialist perspective on the issues in the research); hunters (because they may treat cats as competitors for game species); environmental workers (who likely have a close relationship with nature conservation on the island), and tourists (as non-specialists and non-locals). Questionnaires to local

residents and tourists were freely available in public spaces while hunters and environmental workers were contacted at their respective associations. Adults from both sexes were able to respond. However, it is to be noted that more than 95% of the environmental workers and hunters in La Palma Island are known to be men, with a substantial bias towards older individuals. For this reason, sex and age biases were integral to the purposive sampling process and so were considered only in terms of their limitations for the study..

Between March and July 2012, 400 self-administered questionnaires were distributed amongst the principal villages proportional to the number of inhabitants. Direct and discrete questionnaires allowed avoidance of unintended influence by interviewers (Ash & Adams, 2003).

Questions were divided in three different groups those: (1) concerned with general aspects of biodiversity on La Palma Island Biosphere Reserve, to measure the general knowledge of people about island biodiversity and the related main conservation concerns; (2) addressing specific issues about feral cats and their perceived effect on the conservation of native species; and (3) assessing attitudes towards issues associated with the presence of cats on the island. The questionnaire (Table 1) was distributed in Spanish, English, French and German according to the respondent encountered.

Analysis

Survey data were analysed using chi-square and likelihood ratio tests (G-test), which were commonly used in similar studies (Ash & Adams, 2003; Haspel & Calhoon, 1990) using the total number of answers in questionnaires. When it was necessary to use

the same data set and to avoid Type I error, we applied the more conservative sequential Bonferroni correction (0.05/k) proposed by Rice (1989).

Results

386 of the 400 distributed questionnaires were successfully answered and returned. From these, 320 questionnaires were randomly considered in order to have the same sample size (n = 80) in each of the four social selected groups.

There was no statistically significant difference amongst groups with regard to understanding that island and mainland biodiversity differed (G = 7.67, df = 3, P = 0.053). Habitat destruction and introduction of invasive species were considered the main threats for the conservation of island biodiversity (χ^2 = 405.71, df = 5, P < 0.001) (Fig. 1). Obviously, hunters mainly did not consider hunting as a problem for biodiversity but statistical differences were not observed (χ^2 = 11.84, df = 3, P = 0.008, Bonferroni correction). Other mentioned threats included contamination, climate change and incorrect use of poisons. Of the tourists interviewed, 44 % thought that tourism was one of the main threats to conservation of the island (χ^2 = 41.35, df = 3, P < 0.001) (Fig. 1).

Of the respondents, 73.9% knew that invasive species are present on the island. Tourists showed the lowest knowledge (41%) about this issue (χ^2 = 64.02, df = 3, P < 0.001). Ten species (seven animals and three plants) were cited in 73.7% of the total answers. Among animals, barbary sheeps (*Ammontragus lervia*), rabbits (*Oryctolagus cuniculus*), rats (*Rattus rattus*), mice (*Mus domesticus*) and cats were the most mentioned, while crimson fountaingrass (*Pennisetum setaceum*) was the most cited

plant species (see Annex 1 to check the complete list of mentioned species). Most respondents (77%, n = 182) considered these invasive species to be a substantial problem for the conservation of native biodiversity. However, this concern changes significantly between groups (G = 30.35, df = 3, P < 0.001), more hunters thought that invasive species are not a substantial threat. Of 307 questionnaires, 141 respondents (45.9%) considered competition with native species as the main impact.

Most respondents answered that the presence of cats on the island had a negative effect on its biodiversity. This effect was considered neutral by tourists and local residents and detrimental by hunters (Fig. 2); no statistical differences appeared amongst groups (χ^2 = 16.39, df = 6, P = 0.012, Bonferroni correction). The main cat negative effects mentioned by 127 specific answers were impacts on native species (n = 54) and diseases spread (n = 6). Contrarily, the main positive effect mentioned was their predation of rodents (n = 15).

Nearly all respondents (97.8%, n = 313 of 320 questionnaires) had cats at home (Fig. 3). All interviewed tourists answered that they did not bring their cats with them. For this reason this group was not taken into account in the following questions (8 to 11, see Table 1). Main owners (85.7%) have 1 to 5 cats at home, while some of them (7.1%) maintained 6 to 20 cats; 70 respondents (2.9%) have more than 20 cats and 4.3% of the respondents do not know how many cats they actually have at home. 58% of respondents, among cat owners, did not neuter their cats. No statistical difference was observed amongst respondent groups (χ^2= 1.46, df = 2, P = 0.483). The main reason was that respondents did not think it useful (46%) (G = 21.12, df = 5, P = 0.001). However, economic reasons and no knowing where and when it was done were also mentioned. No other reasons were specifically mentioned.

More than 70% of respondent cat owners said that their cats have free access to natural habitats. On the other hand, most of them (n = 115) answered that when their cats bred, they gave the kittens up for adoption (G = 95.5, df = 8, P < 0.001). Only in 4% of the cases (all of them local residents) was an animal protection association cited as a solution, while 36% of the owners maintain kittens at home as pets and 18% decided to kill them at birth (Fig. 4). Lastly, 7% of the respondent cat owners released kittens into the environment (16.7% of hunters took this decision).

Several alternative management options were proposed to respondents (Table 1). Cat sterilization paid for by the owners was considered the best option by 42% of respondents (including tourists in this last question) and 40.6% considered education campaigns necessary (Fig. 5). The solution was different dependent upon the respondent groups (χ^2 = 133.71, df = 24, P < 0.001). Education programs were the most accepted solution for environmental workers and local residents, while capture and euthanasia was the most accepted by hunters (55.3%). Sterilisation paid for by cat owners was mainly mentioned by tourists possibly representing an assumed cultural norm that was misaligned with that of their destination. Such contradictions between tourist expectations and local practices may impact negatively on tourists' perceptions of their visit, especially if differences are considered to be at the expense of animal welfare (Beckman et al., 2014).

Discussion

This questionnaire was a useful tool to better understand the attitudes of people towards cats and cat impacts upon wildlife as well as their considerations around

appropriate control methods for cat populations (White et al., 2005). The 320 analysed responses represented 0.35 % of the total island population (ca. 87,000 inhabitants plus 23,000 tourists visiting the island during the survey). This percentage, as well as the 95.5% of response rate, is in accordance with the recommended values for robust in-person interviews (White et al., 2005).

In general respondents were aware of biodiversity of the island and the role of invasive species (and specifically cats) in threatening its conservation.

Beyond their value as companion animals, cats were considered useful for the control of rodents (Haspel & Calhoon, 1990). Respondents also used cats to control native insects, lizards, and birds because they are considered to damage crops.

As for other islands (e.g. New Zealand: Farnworth et al., 2010*b*) cat management is not legislatively enforced and most cat owner respondents do not control their pet movements beyond their property. On this island, urban and natural areas are often adjacent and cats can easily move between them, covering long distances and increasing their negative effect on wildlife. Unlike the Farnworth et al. (2010*b*) study in New Zealand most of the inhabitants of La Palma had not sterilized their cats, so companion cats wandering increases both (i) the reproductive dynamics of feral populations and (ii) the predation pressure upon native species (Medina & Nogales, 2009). Plus, inhabitants have a lot of cats at home and they release kittens into natural habitats after their pets breed (Medina & Nogales, 2009). During the survey (five months) at least 11 cats were known to be released in urban and natural areas. Active abandonment of reproductively viable cats requires substantial investigation. This is especially so considering that undesirable owner behaviors (such as abandonment) sustain feral cat populations (Finkler & Terkel, 2012) which, in turn, may pose a risk to protected ecologies (Aguilar and Farnworth 2015).

Respondents commented that neutering their cats is not of primary importance and above all they are not aware of this surgical procedure and its cost. Consequently it appeared (1) a lack of information about sterilization processes considered expensive, complicated and dangerous for cats and (2) a need for education about cat impact on native fauna and natural island ecosystems in general. One solution could be to subsidize sterilizations (Oppel et al., 2014), and convince owners to keep their cats inside their property (Lepczyk et al., 2010). Some authors argue that the more owners care about their cats (i.e. resource, social and health needs) the less impact cats have on prey populations (Kays & DeWan, 2004). However, the harmful effects of free-ranging companion cats upon native species are still substantial, especially when cat population density is high (e.g. Medina et al., 2011).

Differences observed between the four group's answers could represent cultural differences and divergent points of view towards nature and ecosystem preservation. However, it is also important to note that the groups also contained inherent biases, for example hunters and conservation workers were almost entirely male biased samples. It is not possible to extricate such biases from the purposively sampled data and the conclusions drawn should considered in light of this. The most significant difference observed was that hunters, as opposed to other groups, did not consider invasive species a substantial threat to biodiversity conservation efforts. This is likely related to the fact that two of the most pernicious invasive mammals on the island, the rabbit and the barbary sheep, are the most important game animals for them. Furthermore, it was surprising that although hunters reported cats as highly detrimental and requiring lethal control to minimise competition for game, they were the respondent group that most commonly released kittens into the environment. The lack of awareness about conservational requirements within the biosphere is probably due to a lack of enough

informative campaigns about the risks of invasive species, particularly cats. As expected environmental workers demonstrated more specific knowledge as they have received specific education concerning this issue. Lastly, as far as we know, no informative campaigns are presented to the tourists before they visit the island. We consider that educational campaigns are likely the most important effective tools for improving social knowledge about the negative effects of feral and their management (40.6% of respondents in this study; e.g. Loyd & DeVore, 2010).

In general trap-euthanize is considered the most efficient management tool for feral cat population (Loyd & DeVore, 2010). On La Palma Biosphere Reserve, several sterilization campaigns have been conducted by animal rights associations, with the collaboration of the Island Government (Cabildo de La Palma) without specific objectives. Considering the current impacts of cats (Medina et al., 2006), and the results of this questionnaire, the most valuable management action on this island may be to conduct massive owned-cat sterilization campaigns, as well as capture and euthanize feral and stray cats in priority areas for conservation. This could be the best solution for avoiding welfare compromise of cats impossible to adopt (Lepczyk et al., 2010). Although this management action may not be efficient enough to mitigate all issues (Oppel et al., 2011), it is one of the best solutions when total eradication is undesirable or impossible (Farnworth et al., 2011). Similar management decisions have already been applied worldwide to: (1) obtain a compromise between Governments, stakeholders, and pet owners, (2) reduce of prevent abandonment of kittens into the environment, and (3) decrease the number of domestic cats in urban and suburban areas (Hervías et al., 2012).

Conclusions

Cats are currently affecting at least 13 Critically Endangered species on 12 islands worldwide where eradication has been considered as a priority for their conservation, and where effective education or social programs are important tools for increasing the sensitivity of local communities (Nogales et al., 2013). European laws establish that domestic animals must be kept under owner control and their release into nature is forbidden. Without any political emphasis a continuous increase in the feral cat population seems inevitable. As cat control techniques may be unpopular, educational and awareness campaigns are required to increase public understanding and acceptance (Proulx, 1988). Underlying the divergent status and respective impact of neutered domestic, stray and feral cats can improve cat control acceptance (Farnworth et al., 2011). Cat population management is a multi-factorial problem which requires engagement with numerous stakeholder groups. This may prove problematic as such groups, as shown here, may fundamentally differ in their approach to, and consideration of, the issues involved. It is therefore important to promote an adaptive decision–making process which engages all stakeholders (Perry & Perry, 2008; van Heezik, 2010). Only by focussing on areas of consensus can the conflicts which arise between domestic cats, protected ecologies and their respective human caretakers be solved.

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Table 1

Applied questionnaire to know the attitude of La Palma Island Biosphere Reserve inhabitants about the island biodiversity and its conservation

Biodiversity
1. Do you think island biodiversity is different from mainland? 2. In your opinion, what kind of activities can negatively affect biodiversity on the island? – Habitat destruction – Introduced invasive species – Tourism – Agriculture – Others (Specify which ones…) 3. Do you know if there are any plant or animal species on the island that were introduced by humans? If yes, please name them? 4. Do you know if these introduced species are a threat to native species on the island?
Cats
5. What do you think about the presence of cats on the island: useful, detrimental or neutral? 6. What do you think about the impact of cats on La Palma Island?
Human – cat relationship
7. Do you have cats? How many? 8. Are your cats neutered? 9. If no why you do you not neuter your cats? – Economic reasons – To avoid animal suffering – To let them reproduce – It is not necessary – I do not know where and how to do it – Others (Specify which ones…) 10. Do you prevent your cats from leaving your home? 11. When your cats have kittens, what do you do with them? – Give them to an animal protection association – Kill them – Maintain them at home – Release them into the field – Give them to adoption 12. If a conservationist explains that cats have pernicious effects on biodiversity conservation on your island, what do you consider to be viable solutions? – Neutering paid by owner – Neutering paid by public administration – Adoption – Capture and euthanasia – Educational campaign – Keep cats at home – Cat identification – Control cat introduction into the island

Fig. 1. Respondent answers (n = 246) about the main proposed threats that affect the biodiversity on La Palma Island Biosphere Reserve. Statistically significant differences ($P < 0.001$), among threats, occur when the letters are different, *: statistical differences ($P < 0.001$) among respondent groups. Other threats were not included in the statistical analysis.

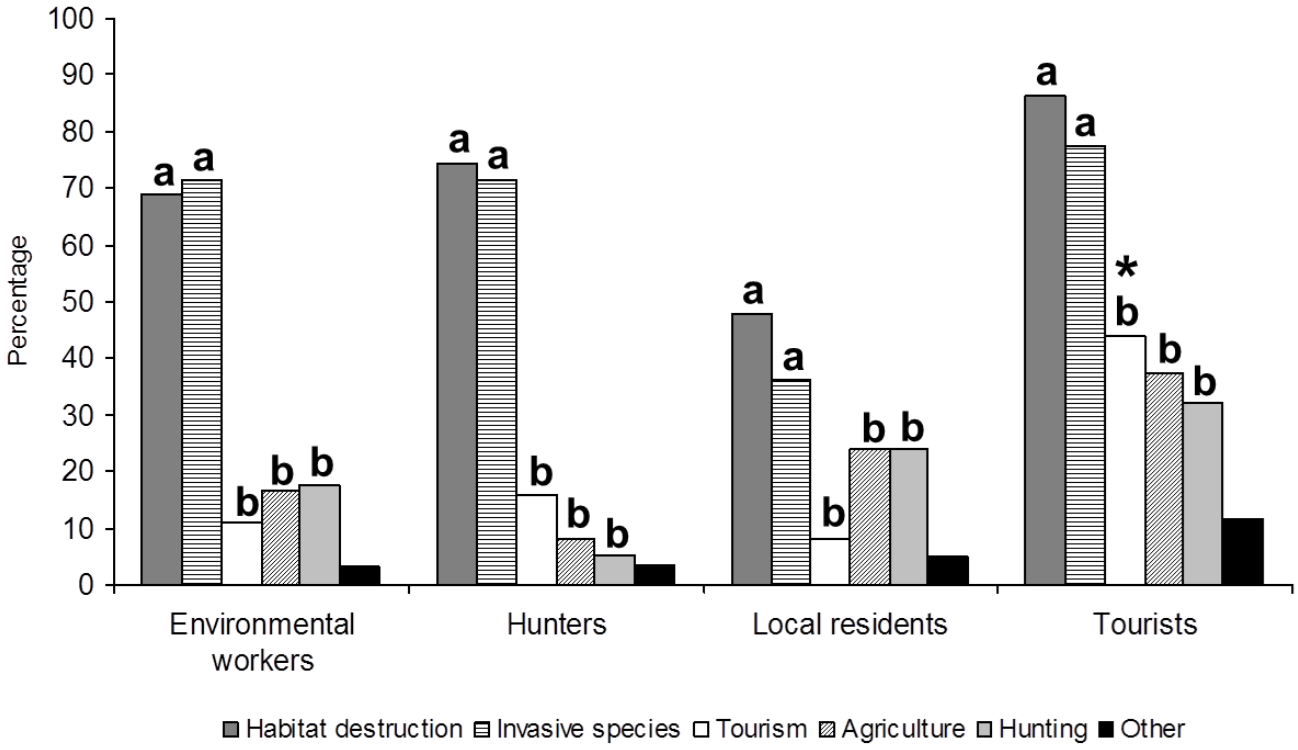


Fig. 2. What the respondents (n = 309) think about the cat effects on La Palma Island Biosphere Reserve.

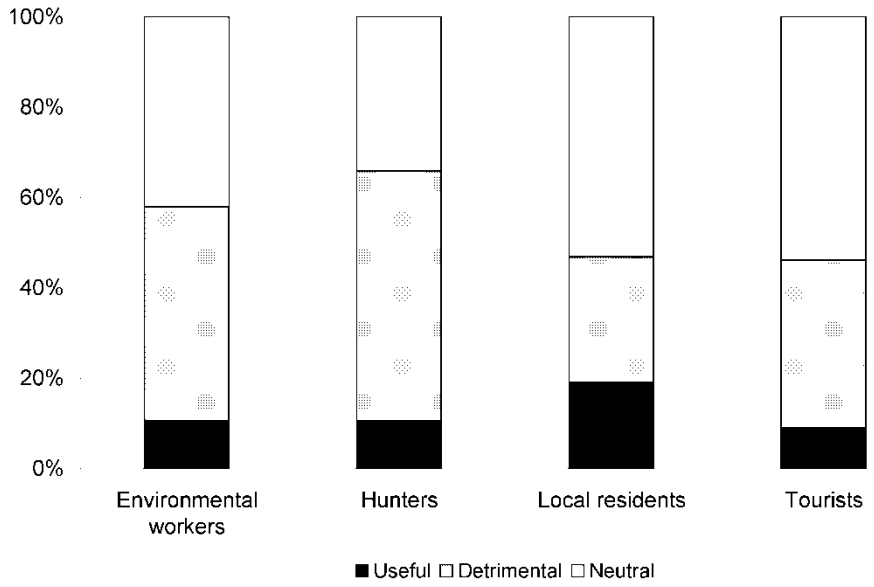


Fig. 3. Farm cats in a locality of La Palma Island Biosphere Reserve.

Fig. 4. What do the respondents (n = 52) do when they have kittens? Statistically significant differences ($P < 0.001$), among threats, occur when the letters are different, Capital letters: statistical differences ($P < 0.001$) among respondent groups.

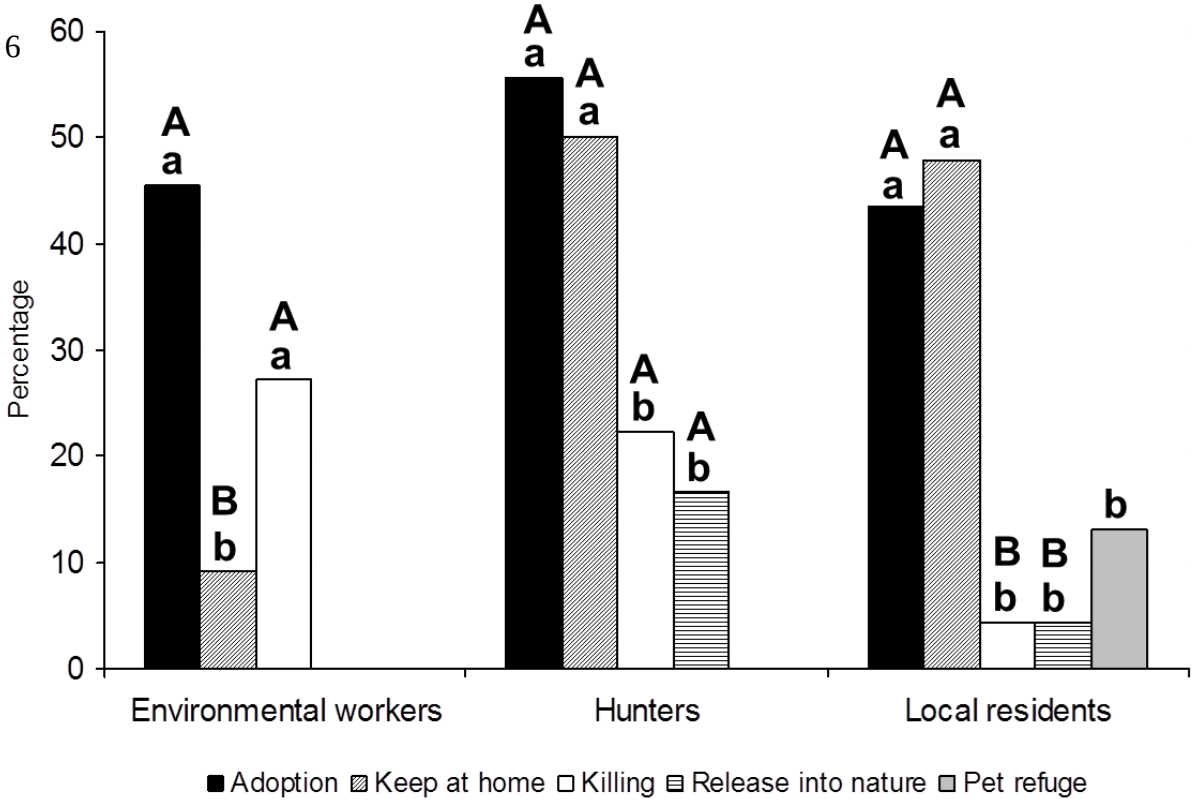
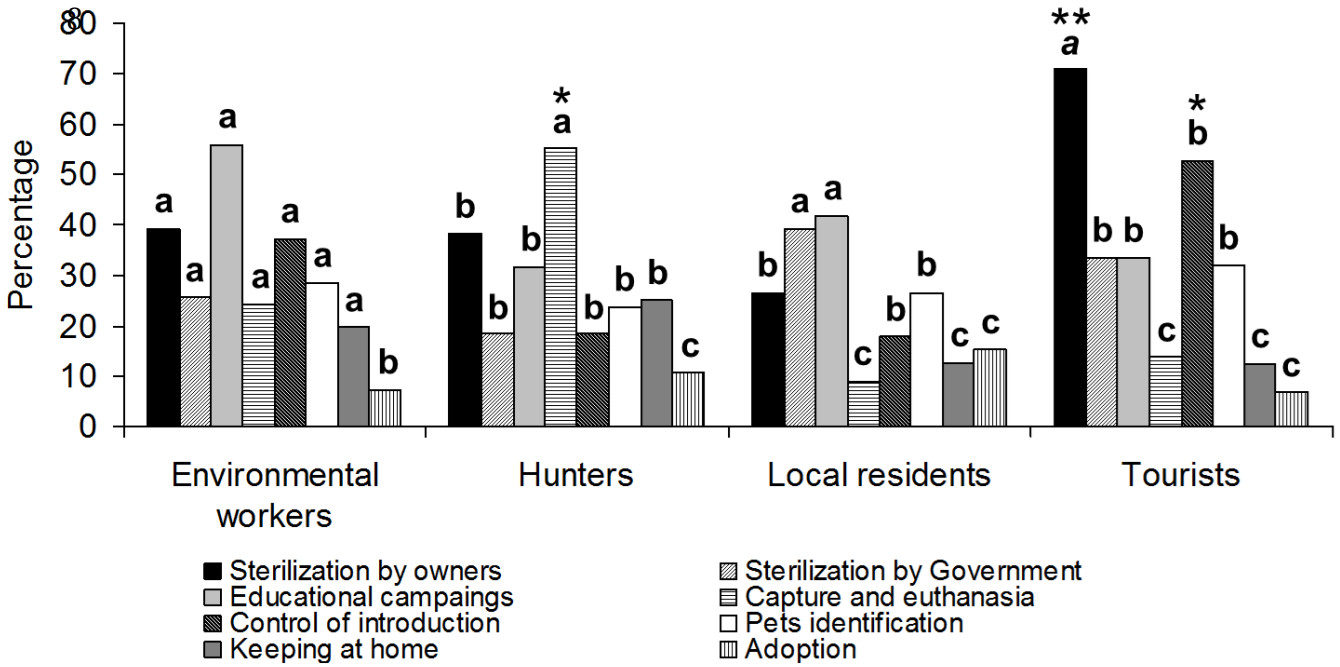


Fig. 5. Possible solutions proposed by respondents (n = 297) to solve the cat presence issue on La Palma Island Biosphere Reserve. Statistically significant differences (P < 0.001), among threats, occur when the letters are different, *: statistical differences (P < 0.001) among respondent groups, ** and italics: $P < 0.05$.



Annex 1.

List of the main invasive exotic species mentioned by respondents and number of time citing regarding question number 3: Do you know if there are any plant or animal species on the island that were introduced by humans? If yes, please name them?

Species	Number
Crimson fountaingrass (*Pennisetum setaceum*)	53
Barbary sheep (*Ammotragus lervia*)	37
Feral cat (*Felis catus*)	28
Rodents (*Rattus* spp - *Mus musculus*)	25
Rabbits (*Oryctolagus cuniculus*)	23
Rose-ringed parakeet (*Psittacula krameri*)	17
Snakesroots (*Ageratina adenophora* and *A. riparia*)	8
Snakes (Or. Squamata)	7
Sweet chestnut (*Castanea sativa*)	5
Dog (*Canis familiaris*)	5
Banana (*Musa acuminata*)	5
Goat (*Capra hircus*)	4
Insects (Hexapoda)	4
Green iguana (*Iguana iguana*)	3
Ferret (*Mustela furo*)	3
Barbary partridge (*Alectoris barbara*)	3
Domestic pigeon (*Columba livia*)	3
Monterey pine (*Pinus radiata*)	3
Barbary falcon (*Falco pelegrinoides*)	2
Tomatoes (*Solanum lycopersicum*)	2
Potatoes (*Solanum tuberosum*)	2
Avocado (*Persea americana*)	2
Eucalypt (*Eucalyptus* spp.)	2
Sugarcane (*Saccharum officinarum*)	2
Tobbaco (*Nicotiana tabacum*)	2
Common walnut (*Juglans regia*)	2
Common fig (*Ficus carica*)	2
Bay laurel (*Laurus nobilis*)	2
Maize (*Zea mays*)	1
Bees (*Apis melifera*)	1
European seabass (*Dicentrarchus labrax*)	1
Horse (*Equus ferus caballus*)	1
Hottentotfig (*Carpobrotus edulis*)	1
Dromedary (*Camelus dromedarius*)	1
Cactus (Fam. Cactaceae)	1
Crocodile (*Crocodylus niloticus*)	1
Acacia (*Acacia* spp.)	1
California poppy (*Eschscholzia californica*)	1
Veiled chameleon (*Chamaeleo calyptratus*)	1
Guinea pig (*Cavia porcellus*)	1
African collared dove (*Streptopelia roseogrisea*)	1
Papaya (*Carica papaya*)	1
Camelus (*Camelus bactrianus*)	1
Almond (*Prunus dulcis*)	1
Mango (*Mangifera indica*)	1
Cockroaches (Or. Blattodea)	1
Barbary ground squirrel (*Atlantoxerus getulus*)	1
Pond sliders (*Trachemys scripta*)	1
Sheep (*Ovis aries*)	1